Historic, archived document

Do not assume content reflects current scientific knowledge, policies, or practices.

1.932
A2Ag32

•EASTERN•REGIONAL•RESEARCH•LABORATORY•

Wyndmoor, Pa.

P. A. Wells, Director.
Chestnut Hill Station
• PHILADELPHIA • PENNSYLVANIA •

BUREAU OF AGRICULTURAL & INDUSTRIAL CHEMISTRY
Agricultural Research Administration
UNITED STATES DEPARTMENT OF AGRICULTURE

AIC-227

MARCH, 1949

LABORATORY STAFF OFFICERS

Director	*P. A. Wells*
Assistant Director	*R. E. Lothrop*
Business Manager	*G. P. Wolf*
Mechanical Superintendent	*F. Macdonald*
Research Division Heads:	
Analytical and Physical Chemistry Division	*B. A. Brice*
Biochemical Division	*J. J. Willaman*
Carbohydrate Division	*C. H. Fisher*
Chemical Engineering and Development Division	*R. K. Eskew*
Hides, Tanning Materials and Leather Division	*J. S. Rogers*
Oil and Fat Division	*W. C. Ault*
Protein Division	*T. L. McMeekin*

VISITING HOURS

The Laboratory is open from 8:30 a.m. to 5:00 p.m., Monday to Friday. It is closed on Saturday and Sunday. Visits should be arranged in advance by telephone (telephone number: CH7-5800) or by mail (mailing address: Philadelphia 18, Pennsylvania). Visitors should register at the information window on entering the building. Those interested in specific fields of the Laboratory work should contact the Head of the Division engaged on that work.

March 1949

EASTERN REGIONAL RESEARCH LABORATORY[1]

BACKGROUND

In 1938 Congress directed the Secretary of Agriculture to establish four regional research laboratories to search for new and wider outlets and markets for farm commodities.

The substance of the legislation creating the Laboratories is contained in the following paragraph, taken from the act: "The Secretary is hereby authorized and directed to establish, equip, and maintain four regional research laboratories, one in each major farm producing area, and at such laboratories to conduct researches into and to develop new scientific, chemical, and technical uses and new and extended markets and outlets for farm commodities and products and by-products thereof. Such research and development shall be devoted primarily to those commodities in which there are regular or seasonal surpluses, and their products and by-products.".

As a preliminary step, Congress directed that a survey be made to find out what research was being conducted in these fields, to obtain suggestions for needed research, and to acquire information that would be helpful in fixing the scope of the research programs of the laboratories. A report of this survey has been published as Senate Document No. 65, 76th Congress, entitled "Regional Research Laboratories, United States Department of Agriculture." Copies may be obtained from the Eastern Regional Research Laboratory.

---

[1] Ardmore Avenue and Mermaid Lane, Wyndmoor, Pennsylvania (Springfield Township, Montgomery County).

More recently Congress enacted legislation called the "Research and Marketing Act of 1946," which authorized additional research on the utilization of agricultural commodities. Under this act, the Laboratory has undertaken utilization studies on three new commodities and has expanded the research on some of the commodities already under investigation.

ADMINISTRATION

The four Regional Research Laboratories are under the administration of the Bureau of Agricultural and Industrial Chemistry. In addition to the four Laboratories, the Bureau includes a number of smaller research groups.

The Bureau is in turn one of the seven research bureaus which constitute the Agricultural Research Administration. Through the Administration, the scientific investigations of the United States Department of Agriculture are coordinated, and working relationships are maintained with the State Agricultural Experiment Stations.

The offices of the Bureau and the Agricultural Research Administration are located in Washington, D. C. G. E. Hilbert is Chief of the Bureau; C. F. Speh, G. W. Irving, and H. A. Donovan are Assistant Chiefs. P. V. Cardon is the Research Administrator.

ORGANIZATION

As directed by Congress, one of the four Regional Research Laboratories is located in each of the major farming areas of the United States. The Eastern Laboratory serves the eastern area, comprising the New England States, New York, New Jersey, Pennsylvania, West Virginia, Maryland, Delaware, North Carolina, Virginia, Tennessee, and Kentucky. The work of this

Laboratory is organized under seven major research divisions. The commodities assigned for study are: Apples and other eastern deciduous fruits, vegetables, tobacco, milk products, animal fats and oils, potatoes, hides, tanning materials and leather, honey, maple products, and wool by-products.

The other three Regional Research Laboratories[2] are somewhat similarly organized. The buildings and facilities of the four Laboratories are also similar. Commodities important to its area have been assigned to each Laboratory. Research on a few commodities is divided between Laboratories.

BUILDING

The Eastern Laboratory is built on a 32-acre tract of land located just outside Philadelphia. It is close to the great processing industries along the Delaware River and to reference libraries and research activities at the University of Pennsylvania, the Franklin Institute, and other educational institutions.

The Laboratory building is a U-shaped structure of three stories and basement. Offices, library, conference rooms, and other general services are in the front of the building, which is the 211-foot base of the U. One of the wings contains research laboratories equipped for work in chemistry, physics, and microbiology. The other contains a few laboratories, but most of the space is used for pilot-plant operations. Since pilot-plant research is stressed, almost one wing, or roughly one-third of the building, is utilized for pilot-plant investigations. Service shops and special research rooms are located in the basement. Altogether the building contains 72 research laboratories, in addition to the pilot plant and special research rooms. For the most part, the research laboratories are arranged in 3-bay units, consisting of two research rooms with a utility room and two small offices between them. Both the offices and the laboratories are air-conditioned.

---

[2] ADDITIONAL INFORMATION IS GIVEN ON PAGE 18.

RESEARCH PROGRAM

The research program of the Regional Research Laboratories places special emphasis on industrial uses for farm crops rather than food uses, although development of new food used is an important part of the program. There are greater possibilities for increased outlets in new industrial uses, since human capacity for food is limited, whereas capacity to use products of industry or manufactured goods is virtually limitless. In the past the farmer has produced the raw materials for food, clothing, and shelter. This is still his main business, but modern civilization also provides a rapidly expanding market for other kinds of goods, ranging from cosmetics to airplanes. Industrial uses based on these secondary human needs promise greatly expanded outlets for farm commodities.

The principal fields of work and the objectives of the seven research divisions of the Laboratory are as follows.

Protein Division. The Protein Division is seeking to extend the industrial uses for proteins, especially casein and other milk proteins. One project has for its goal the improvement of casein textile fiber. Greater tensile strength of wet casein fiber would make possible wider applications of this product. Another project is concerned with studies on casein fiber for use as bristles. Still another research is directed toward the improvement of molded protein plastics. Here the main problems are to curtail absorption of water and to devise more rapid and economical processing methods. Basic studies on the composition, structure, and behavior of proteins comprise an important phase of this program.

Carbohydrate Division. The Carbohydrate Division is conducting research on milk sugar, or lactose, another potentially valuable constituent of milk. Milk sugar as such has many uses, and in addition it serves as a raw material from which a number of valuable products are derived. For example, milk sugar in whey is readily fermented to lactic acid, which in turn can be converted into acrylic resins and other useful substances.

This Division is also seeking new industrial uses for white potatoes. Problems being investigated include the manufacture of starch from white potatoes and its industrial application, as well as the preparation of other products, including products from the starch.

Hides, Tanning Materials, and Leather Division. This Division studies the raw materials and processes used in making leather. The principal raw materials are: (1) Hides and skins of various animals, such as cattle, sheep, and goats, and (2) vegetable and mineral tanning agents, which consist of tannins obtained from chestnut wood, hemlock bark, sumac leaves, and similar vegetable sources, and the salts of chromium and aluminum. The Division is seeking new and better sources of domestic vegetable tannins. It is also trying to develop new processes that will make more serviceable leathers, and to devise methods of preventing deterioration of leather goods. Another important project is research on methods for preventing spoilage of hides and skins before tanning. Basic studies on the composition, structure, and behavior of the tannins are included in the program of this Division.

Oil and Fat Division. A major objective of the Oil and Fat Division is to extend the industrial uses for animal fats and oils and wool grease. The research is directed to the preparation of new plastics, plasticizers, waxes, detergents, and similar articles of commerce in which fats and oils are used as raw materials.

Another important project is to improve the properties of edible animal fats. Better methods for delaying rancidity, for instance, would help to overcome one of the most serious defects of these foodstuffs.

Biochemical Division. The Biochemical Division is assigned the task of finding new uses for four commodities--apples, vegetables, tobacco, and honey. Problems under investigation include (1) development of better methods of processing and storing apple juice and investigations of other apple products, (2) preparation of vitamin concentrates and high-protein, high vitamin leaf meals from vegetable wastes for use as animal feed, (3) development of new nicotine insecticides and other nicotine derivatives, and (4) improvement in quality of the lower grades of honey to extend its use.

Analytical and Physical Chemistry Division. The Analytical and Physical Chemistry Division conducts specialized analytical, physical, and physical chemical investigations on the various commodities assigned to the Laboratory. Chemical analyses and physical tests required by the other Divisions are also made here. These include analyses for moisture, ash, carbon, hydrogen, sugars, metallic elements, and other organic and inorganic substances. This Division also evaluates the fibers, plastics, rubber, and other products developed in the Laboratory, determining such properties as hardness, resilience, and tensile strength.

Another project of this Division is a study of the composition of tobacco for the purpose of obtaining constituents, other than nicotine, of commercial value. Studies aimed at improving the quality and flavor of maple sirup and other maple products are also carried out by this Division.

Chemical Engineering and Development Division. A large part of the work of the Chemical Engineering and Development Division is pilot-plant research. Research work at the Laboratory does not stop at the test-tube stage. Processes and products that look promising for commercial development are transferred to the pilot plant, which is a miniature model of an industrial plant. Here are studied the probable type of equipment required for large-scale operation, the materials of construction, the behavior of the reactants and the product in large bulk, and the cost of manufacture. At this stage many of the "kinks" incidental to industrial production and marketing are ironed out. This Division also designs equipment and large-scale apparatus and provides engineering consulting service for the entire Laboratory.

PROGRESS

The following developments represent typical achievements of the Laboratory. In addition, a large amount of basic research has been done that lays the ground work for future developments. It is from this basic exploratory type of research that future specific accomplishments will come.

Rutin from Buckwheat and Tobacco. In conducting studies on various constituents of tobacco, a member of the laboratory staff obtained the flavonol glucoside rutin from flue-cured tobacco. The occurrence of rutin in tobacco and other plants had been known for a long time, but no use had ever been found for it.

Its structure led him to think that rutin might possess the so-called "vitamin P" activity, and he interested members of the University of Pennsylvania medical staff in conducting clinical tests. These tests showed that rutin was effective in the treatment of increased capillary fragility, and physicians elsewhere have fully confirmed these results. Bursting of weakened blood vessels causes small hemorrhages which, when the rupture occurs in the eye or brain, may result in blindness or apoplexy. Clinical results also indicate that rutin may be effective in the treatment of a number of other diseases and conditions associated with capillary fragility.

Because of the rather low rutin content and high cost of flue-cured tobacco, the only type of tobacco that contains rutin in appreciable quantities, other sources of rutin were sought. Buckwheat has proved superior to other plants investigated, having 8 to 12 times as much rutin and costing only a fraction of the price of flue-cured tobacco leaves. The drug occurs in the leaves and blossoms, the maximum content being present from 5 to 6 weeks after the seed has sprouted. Buckwheat grain is totally lacking in rutin.

Clinical evaluation studies required large quantities of the drug. The Eastern Regional Research Laboratory prepared the rutin needed; for a while it was the only source of the rutin required for clinical and pharmacological testing. Many problems had to be solved before rutin could be produced commercially. As a result of the Laboratory's work, rutin became available commercially in 1946. It is now established as a valuable therapeutic agent that has world-wide use in the treatment of hemorrhagic diseases. If the anticipated widespread demand for rutin materializes, it is estimated that eventually approximately 10 percent of the buckwheat crop will be used for this purpose.

Apple Sirup. The Eastern Laboratory has studied the preparation of various types of sirup and concentrate from apple juice. Owing to the demand for a low-calcium sirup, a process has been developed for manufacture of such a sirup. This is a bland sirup, that is, it does not have the tartness and flavor of apples. It differs from sirup previously developed by the Laboratory in not having the slightly bitter aftertaste that results from the presence of calcium salts. The product is satisfactory as an ingredient in table sirups, beverages, cosmetics, and pharmaceuticals.

The process for preparing this new type of sirup from apple juice is based on ion exchange. It comprises filtration of the juice, passage through a bed of anion-exchange material that absorbs the malic acid, liming, filtration to remove precipitated calcium pectate, acidification, and concentration under vacuum. Two companies have produced this sirup commercially.

Another type of bland apple sirup developed by the Eastern Regional Laboratory has assumed commercial importance as a humectant for tobacco. Two to three million pounds have been produced annually, and several manufacturers have used it in their formulas for cigarette tobacco. In addition to keeping tobacco moist, apple sirup helps to develop the aromatic fragrance of Burley pipe-smoking tobacco.

Apple Essence. The Eastern Laboratory has developed a process for recovering the volatile flavoring constituents of apple juice in the form of an essence. One gallon of the essence is obtained from approximately one ton of apples. Blending this essence with a good grade of commercial apple-juice concentrate results in a full-flavor concentrate. With the mere addition of water, this becomes a beverage having the taste and aroma of fresh apple juice. The process for preparing apple essence comprises the following steps: (1) Rapid evaporation of about 10 percent of the juice; (2) mechanical separation of the vapors from the unvaporized juice; and (3) fractional distillation of the vapors to obtain a concentrated flavor or essence.

A mimeographed circular (AIC-63) describes the process and equipment, and estimates the costs for the large-scale manufacture of apple essence.

In addition to its use for preparing beverages, apple essence has found application as an ingredient in a wide variety of food products, which include sherbets, ices, fruit jellies, table sirups, and confections.

Since much of the sirup made commercially from apple juice goes into products for which the natural apple flavor is of no value, the volatile flavoring constituents now discarded in the preparation of these sirups can be obtained in concentrated form by this new process and sold as the natural-flavor essence.

The process has also been used to recover the flavor from the juices of several other fruits, although modifications are required to adapt the process to some of them. This process should make it possible to produce jellies, jams, preserves, and bottled beverages having improved true fruit flavor at a negligible increase in cost.

Food processors have shown a marked interest in the production and use of full-flavor juice products, such as can be made with the essence obtained by this process. At least 30 companies have produced, or are producing, essence from apples and other fruits.

Casein Bristle Fiber for Brushes. The Eastern Laboratory has developed an extruded casein bristle fiber suitable for use in brushes, particularly paint brushes. The process for making the fiber is simple. It consists in extruding the plasticized casein (the principal protein of milk) through a die and hardening and stretching the extruded fiber. Other promising uses for the fiber are for stiffening cloth, in furniture stuffing and air filters.

In response to the commercial interest in casein bristle, research on this product has been directed toward evolving a completely continuous process of manufacture. By designing and constructing the proper equipment, the Laboratory has developed a completely continuous process. In developing this process, advantage has been taken of the fact that hardening the fiber with quinone and other agents proceeds more rapidly at temperatures above 100° F. than at room temperature. By using higher temperatures, the time required to harden the fiber is reduced to such an extent that the operation is accomplished while the fiber advances on an automatic reel. Continuous manufacture is more economical and yields a somewhat more uniform product.

One commercial firm has undertaken the manufacture of the casein bristle developed by the Eastern Laboratory. There appears to be an excellent future market for bristle material, and it is estimated that casein bristle can be produced at a cost markedly lower than the cost of natural bristle or of other competing artificial bristle.

Acrylic Rubbers. A new synthetic rubber, called "Lactoprene," made entirely from agricultural products, has been developed by the Eastern Laboratory. Details of the process consist in converting starches or sugars into lactic acid by a fermentation procedure.

The lactic acid in turn is transformed into acrylic esters by chemical means. The esters are converted into rubberlike materials by a process called polymerization. These materials are then compounded on a mill with rubber compounding ingredients, including sulfur and accelerators, and "cured" or vulcanized in a heated press. The vulcanization methods used are essentially the same as those used for processing natural rubber. Lactoprene designates a family of elastomers instead of one product, since different types of rubberlike material can be obtained by using different acrylic esters as the starting material.

Lactoprene should be suitable as a specialty rubber for many purposes. Results thus far obtained, however, indicate that it is most suitable for uses for which unusual resistance to high temperatures, oils, oxidation, and mechanical flexing, as well as cut-growth resistance, is required.

This new product promises to open a wider field for the industrial utilization of lactose and other fermentable carbohydrates. One commercial company has undertaken its manufacture and commercial development.

Allyl Starch. The Eastern Laboratory in its research on the utilization of carbohydrates has developed a method for preparing highly substituted allyl ethers of starch, products that are finding industrial uses. Allyl starches soluble in organic solvents have been prepared for the first time.

The method consists in treating the starch with allyl chloride (made commercially from a by-product of petroleum distillation) in the presence of concentrated sodium hydroxide and acetone. This method makes possible the commercial production of allyl starch at a relatively low cost.

The most promising use of allyl starch is its use as a coating material. When applied in solution to the surface of wood, paper, or metal, it forms a smooth glossy coating. When this coating is subjected to heat or long standing, it becomes extremely resistant to the agents that often damage varnished surfaces, that is, it is no longer soluble in ordinary organic solvents, it is not affected by heat up to 400° F., and it resists the action of hot oils and moderately concentrated acids and alkalis. A number of catalysts accelerate this polymerization or insolubilization of allyl starch.

Allyl starch compounded on a rubber-working mill with various ingredients used in rubber products, including sulfur and vulcanization accelerators, and subjected to long-continued heating yields a hard thermoplastic composition highly resistant to organic solvents, oils, acids, alkalis, and heat. Such a plastic can be used as an adhesive for the preparation of laminated materials of good strength and quality from paper, fabrics, and wood veneer.

Three commercial concerns are making allyl starch on a limited scale for more complete evaluation and commercial development.

Improved Soap Emulsifiers for Synthetic Rubber Manufacture. The kind of synthetic rubber produced in greatest volume (GR-S) is made by copolymerization of butadiene and styrene while they are suspended as minute globules in an emulsion. Inconsistent results had been obtained in the polymerization process, and it was suspected that some tallow soaps used in preparing the emulsion contained substances that retarded polymerization.

The Eastern Laboratory undertook an investigation of tallow and tallow soaps as a part of the comprehensive research program of the Rubber Reserve Company. A number of universities and several rubber companies and soap manufacturers also participated in this program. These joint investigations led to the conclusion that the tallow soaps used were responsible for the difficulty. As a remedy, it was suggested that the tallow be subjected to mild selective hydrogenation before it is used for the preparation of soap. This treatment is now used in the commercial production of tallow soaps.

This discovery has resulted in an increased rate of polymerization and, for the first time, a fixed production cycle. The fixed cycle, in turn, has effected a substantial increase in the production capacity of GR-S synthetic rubber plants without any increase in existing plant facilities. Furthermore, the superior grade of emulsifier came at a time when the copolymer plants were changing over to continuous polymerization, which requires the utmost uniformity in raw materials and reaction rates.

The spectrophotometric method of analysis, developed at the Eastern Laboratory, was found by the Rubber Reserve Company to be superior to any chemical test or combination of chemical tests for detecting residual polyunsaturated fatty acids in the hydrogenated fats and their soaps. Accordingly, this method was adopted throughout the industry for control purposes and for incorporation in the new specifications for purchase of the soaps.

The Rubber Reserve Company specified that all its soap, estimated at more than 100,000,000 pounds for 1946, shall be hydrogenated to a uniformly low content of polyunsaturates, as shown by spectrophotometric analysis. These requirements can be met by nonedible tallows and greases, edible tallows being no longer required. The research on tallow emulsifiers not only contributed substantially to the synthetic rubber program, but it has also been instrumental in maintaining a large and important outlet for animal fats.

Animal Feeds from Vegetable Wastes. The Eastern Laboratory has developed a process for the preparation from vegetable wastes of high-vitamin, high-protein leaf meals suitable for poultry and other animal feeds. The process consists essentially in rapidly drying the green material in a conventional-type continuous drier to the stage where the leafy portion, which contains most of the nutrients, is dry, while the stems and midribs are still moist and pliable. The embrittled leafy portion is separated from the rest of the plant, thereby concentrating the nutrients in the leaf meal.

The value of these meals in poultry feeding has been demonstrated in extensive feeding experiments carried out in cooperation with the Delaware Agricultural Experiment Station. Chick feed tests have shown that carotene extract from leaf meals will replace vitamin A from fish oils, unit for unit. Broccoli leaf meal is so concentrated as a source of carotene and other green-leaf factors that 1-1/2 percent will replace 5 percent of alfalfa in chick rations and 1 percent plus a small amount of riboflavin will produce better growth when fed to broilers than 5 percent alfalfa or a first-quality broiler mash. Broccoli leaf meal in laying rations resulted in better egg production than larger amounts of alfalfa and fish liver oil. Other tests have indicated that mixed pea and lima bean leaf meals and spinach and beet meals are excellent in broiler rations.

Mold Resistant Treatment for Leather. A mold-resistant treatment for carrying cases and other leather ordnance items has been developed by the Eastern Laboratory as the result of a request from the Ordnance Department of the United States Army. Extensive testing of numerous fungicides in combination with various solvents and wax concentrations showed that a solution containing 2.2 percent salicylanilide, 33 percent paraffin wax, 25 percent isopropyl alcohol, and 40.8 percent Stoddard solvent was most effective. Leather items treated with this solution have proved highly resistant to attack by molds. They do not absorb water so readily as untreated items, and do not soften so markedly when wet. Completely fabricated cases can be successfully treated, thus making it possible to give protective treatment to large lots of cases already manufactured. The Laboratory has assisted the Army Ordnance Department in preparing procurement specifications for the solution and also in preparing directions for applying the treatment to newly manufactured cases and to those already in the field.

Flour from White Potatoes. The United States normally manufactures about 12,000,000 pounds of white potato flour per year, which is used largely in the baking industry. Because of the large surplus of potatoes in 1948 and the increased European demand for potato flour, the Government diverted substantial quantities of potatoes to flour manufacture for shipment to Europe. This immediately presented the problem of finding additional manufacturing facilities, since the potato-flour manufacturing capacity was not adequate to produce the several hundred million pounds of flour required. As the result of pilot-plant studies carried out at the Eastern Laboratory, a process was devised by which double-drum driers in distilleries could be adapted to make flour. This process has been used to produce large quantities of potato flour.

The Laboratory also developed a new process for making potato flour at a cost about one-third below that for the standard procedures used. The new process is cheaper because it converts whole potatoes into flour without the conventional peeling and cooking and it employs low-cost drying methods. Lowering the cost of potato flour should help to expand the market for surplus potatoes through wider use of potato flour.

GENERAL INFORMATION ABOUT THE FOUR REGIONAL RESEARCH LABORATORIES

Laboratory	Director	Mailing address	Area served	Commodities studied
Northern	R.T. Milner	825 North University St., Peoria 5, Illinois	Ill., Ind., Iowa, Kans., Minn., Mo., Nebr., N.Dak., Ohio., S.Dak., Wis., Mich.	Agricultural residues corn, wheat, and other ceral crops soybeans and other oilseed crops.
Southern	W.M. Scott	2100 Robert E. Lee Blvd. New Orleans 19, La.	Ala., Ark., Fla. Ga., La., Miss., Okla., S.C., Tex.	Cotton, sweetpotatoes, peanuts; and rice.
Eastern	P.A. Wells	Philadelphia 18, Pa.	Conn., Del., Maine, Ky., Md., Mass., N.H., N.J., N.Y., N.C., Pa., R.I., Tenn., Vt., Va., W. Va.	Apples and other eastern deciduous fruits; vegetables tobacco, milk products, animal fats and oil; potatoes, hides, tanning materials and leather honey, maple products and wool by products.
Western	M.J. Copley	800 Buchanan Street, Albany 6, Calif.	Ariz., Calif., Colo., Idaho, Mont., Nev., N.Mex., Oreg., Utah, Wash., Wyo.	Fruits, vegetables, poultry products, alfalfa, wheat, apples, potatoes, rice; and wool.